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Local planning v. national policy

Urban growth near nuclear power stations in the United States

The siting of nuclear power plants in the United States has been guided by a clear policy of seeking locations remote from population and urban growth. But these remote locations have failed to prevent population growth near nuclear power plants; communities hosting these facilities experienced, as a whole, a rate of population growth in the last decade more than three times the national average. In order to determine the role played by local planning practices near nuclear power facilities, and the extent to which the nuclear facilities themselves may be stimulating growth, a survey was made of 204 local governments, all within 10 miles of one of the 49 operating nuclear power station sites in the United States. The findings suggest that Federal, State and local governments should reconsider the policies that send nuclear stations, and, quite often, their tax revenues, into local jurisdictions which then strive to promote growth around these sites rather than restrain it.

One way of controlling the number of people exposed to a risk is to prevent them from living near it. The growing list of potentially dangerous facilities includes such hazards as toxic waste dumps, petrochemical production plants, grain silos, LNG terminals, airports, and nuclear power stations. The US Atomic Energy Commission (AEC) and its successor agency, the US Nuclear Regulatory Commission (NRC), have subscribed to the logic that 'remote' locations are desirable for nuclear power stations in the very unlikely, though conceivable, event that an accident should occur and the facility's emergency systems should fail. The extra margin of safety provided by remote locations is part of the NRC's 'defense-in-depth' strategy which uses population distribution and distance to

* The opinions expressed in this paper are solely those of the authors and in no respect represent the views of either the US Nuclear Regulatory Commission, Argonne National Laboratory, or Brookhaven National Laboratory.

supplement engineered safety features. NRC population guidelines¹ recommend that the site area population density should not exceed '500 persons per square mile averaged over any radial distance out to 30 miles', including a weighted transient population, at the time of initial plant operation. At the end of the plant's operating lifetime, this population density is not to exceed 1000 persons per square mile (386 per square kilometre). An additional requirement sets forth a minimum distance between a site and a population centre of over 25 000 people, using a mathematical formula to define this population-distance relationship. Once a remote site has been selected for a nuclear plant, in accordance with NRC population guidelines, then the question remains, 'Will future population growth be kept within the prescribed limits?'

Population growth around this nation's operating nuclear power stations has become a problem. Five sites, out of a total of 49, exceed the population density guidelines. Concern has been expressed that the number of sites experiencing excessive growth will soon increase dramatically. In a recent NRC-sponsored study of population and land-use change in the vicinity of the 49 sites at which there are one or more operating plants in the United States, the populations of 45 of the 49 communities hosting the nuclear stations increased during 1970–1980.² This, of course, is the period when most plants came on-line.

Excluding one of the 49 communities, because of census boundary changes, the total population of the remaining 48 host communities (the local municipal jurisdictions within whose boundaries the sites are located) grew from 335 000 to 450 000, an increase of 34.5 per cent. That is a growth rate of more than three times the national growth rate of 11.4 per cent and exceeds that experienced by 87 per cent of the more than 3000 county governments in the United States in the decade from 1970 to 1980. Seventy-six per cent of the host communities experienced greater growth during that decade than their surrounding (10 mile radius) regions, compared with only 56 per cent during the previous decade. In host communities, analysis further shows that growth is due to local causes, not accounted for by county, regional, or national population trends. Indeed, twenty-nine of the 49 sites (59 per cent) are in the Northeast and North Central regions of the United States, areas of slow growth or decline.

What are the local causes of this growth? Early in 1982, a questionnaire designed by Brookhaven National Laboratory, as part of an NRC-sponsored study of population and land use, was mailed to land use planners and local government officials responsible for and/or knowledgeable about land use concerns within 10 miles (NRC's evacuation planning distance) of all commercially operated nuclear power stations (see Table I and Fig. 1). In general, the questionnaire asked 'Is local government willingly accepting the additional population growth in host communities, in spite of NRC guidelines and perceived risk to the public? If so, why is this happening?' The purpose of the research reported here is to determine, from the questionnaire responses, the causes of the local population growth in communities around nuclear stations and to assess the manner and extent to which local planning and land use policies have attempted to deal with those factors.

Table 1 *Operational nuclear power plants*

<i>Plant Name</i>	<i>Location (County, State)</i>
1. Arkansas	Pope, Arkansas
2. Duane Arnold	Linn, Iowa
3. Beaver Valley	Beaver, Pennsylvania
4. Big Rock Point	Charlevoix, Michigan
5. Browns Ferry	Limestone, Alabama
6. Brunswick	Brunswick, North Carolina
7. Calvert Cliffs	Calvert, Maryland
8. Connecticut Yankee	Middlesex, Connecticut
9. Cook	Berrien, Michigan
10. Cooper	Nemaha, Nebraska
11. Crystal River	Citrus, Florida
12. Davis-Besse	Ottawa, Ohio
13. Diablo Canyon	San Luis Obispo, California
14. Dresden	Grundy, Illinois
15. Farley	Houston, Alabama
16. Fitzpatrick Nine Mile Point	Oswego, New York
17. Fort Calhoun	Washington, Nebraska
18. Fort St Vrain	Weld, Colorado
19. Ginna	Wayne, New York
20. Hatch	Appling, Georgia
21. Indian Point	Westchester, New York
22. Kewaunee	Kewaunee, Wisconsin
23. LaCross	Vernon, Wisconsin
24. Maine Yankee	Lincoln, Maine
25. McGuire	Mecklenberg, North Carolina
26. Millstone	New London, Connecticut
27. Monticello	Wright, Minnesota
28. North Anna	Louisa, Virginia
29. Oconee	Oconee, South Carolina
30. Oyster Creek	Ocean, New Jersey
31. Palisades	Van Buren, Michigan
32. Peach Bottom	York, Pennsylvania
33. Pilgrim	Plymouth, Massachusetts
34. Point Beach	Manitowoc, Wisconsin
35. Prairie Island	Goodhue, Minnesota
36. Quad Cities	Rock Island, Illinois
37. Rancho Seco	Sacramento, California
38. Robinson	Darlington, South Carolina
39. St Lucie	St Lucie, Florida
40. Salem	Salem, New Jersey
41. San Onofre	San Diego, California
42. Sequoyah	Hamilton, Tennessee
43. Surry	Surry, Virginia
44. Three Mile Island	Dauphin, Pennsylvania
45. Trojan	Columbia, Oregon
46. Turkey Point	Dade, Florida
47. Vermont Yankee	Windham, Vermont
48. Yankee Rowe	Franklin, Massachusetts
49. Zion	Lake, Illinois

Fig. 1 Stations with operating nuclear power reactors in the United States, 1984



The data and their limitations

Much interest was expressed among questionnaire respondents, as shown by the 92 per cent response rate (191 out of 204). Twenty-five single and multiple response questions, containing about 200 items, asked what has caused increases and decreases in site area populations (for both the entire 10-mile radius and specific communities); what are the attitudes toward and accomplishments of land use control of residential, commercial, and industrial development; and what are the future concerns about the nuclear stations? In addition to answering the questions, respondents added written comments which totalled 83 pages when assembled and were catalogued by topic, question, and plant.³

The 191 responses were classified as coming from three types of jurisdictions: non-host communities ($n=145$); low-growth host communities ($n=34$); and high-growth host communities ($n=12$). Non-host communities are communities within ten miles of the nuclear plant, but do not include the host communities in which the plants are situated. The high-growth hosts were identified by previous research to have exceptionally high rates of population growth.

It has been shown elsewhere that the 12 high-growth host local governments experienced 60 per cent of the population growth of the full set of 49 host communities between 1970 and 1980 (see Table 2). They also experienced substantially more population growth than would have been expected had they grown at the same rate as their neighbouring communities. The population in the community hosting the Browns Ferry facility in Alabama, for example, increased

Table 2 Twelve host communities that experienced an unusual amount of population growth, 1970-1980*

Plant Name, State	Population Change, 1970-1980	
	Total	Local growth component†
Turkey Point, Florida	23 008	15 201
Pilgrim, Massachusetts	17 307	14 853
Oyster Creek, New Jersey	9545	6697
Rancho Seco, California	4844	3002
Browns Ferry, Alabama	3621	3195
Fort Calhoun, Nebraska	1938	1744
Fitzpatrick, New York	1836	1921
Zion, Illinois	1533	1226
Ginna, New York	1466	1790
McGuire, North Carolina	1462	1190
Connecticut Yankee, Conn.	1449	1412
Peach Bottom, Pennsylvania	1268	1072
a. Total 1-12	69 277	53 303
b. Total 49 host communities	115 562	38 268
(a/b) × 100	60	139

* These are the 49 communities hosting a facility, not all the communities within 10 miles of a nuclear power station.

† The local growth component is the amount of growth that could not be accounted for by national, regional, and host county (excluding host community) population growth rates during 1970-1980.

Source: Greenberg, Krueckeberg, and Kaltman, Notes and References 2.

during the 1970s from 20 352 to 23 973, an increase of 3621. Had the community grown at the same rate as its surrounding communities, it would have increased by only 426 people. It is these 12 local governments that present the most serious planning problems and therefore receive the most attention below.

In working with the questionnaire data, two special problems emerged. One was that not every one of the 49 plant sites is represented by the same number of respondents. Due to differences in the normal size of political units in different parts of the United States, a ten-mile radius around a plant can in some cases overlay only parts of one or two jurisdictions, in other cases it may overlay many. Nine plant sites produced between six and fifteen responses each. Six of those nine (Millstone, Connecticut; Indian Point and Fitzpatrick, New York; Maine Yankee, Maine; Yankee Rowe, Massachusetts; and Vermont Yankee, Vermont) are in the Northeast where political units are generally small in land area. The other three areas with six or more responses were the Trojan, Oregon; McGuire, North Carolina; and Zion, Illinois. Thus, these nine stations (18 per cent of stations) contributed 64 responses (34 per cent of responses).

On the other hand, 14 sites produced only one or two responses each. In some instances there was only one surrounding political jurisdiction that could respond. These site areas were not in the Northeast. Seven of the 14 were in the South. We considered computing a single, average response for each site. We rejected this idea because a great deal of information about some of the most interesting communities would have been lost in the computation.

The second data concern was with the accuracy of the responses. This is a generic problem in most survey research. Our particular concern was that the

respondents might bias the answers because the NRC was involved in the survey. We attempted to check the quality of the responses. Some responses, such as estimates of population density increases, could be verified using known population changes. These checks showed near perfect accuracy. While these may not be the questions that would invite deliberately false responses, close attention was paid to this concern in the analysis of the survey results.

Detailed results of the questionnaires

THE QUESTIONS ON GROWTH AND ITS ENCOURAGEMENT

First, the respondents were asked to characterise the land use changes and policies that have affected growth since construction of the plant. The vast majority reported increases in urban land uses. Seventy per cent observed some increases in the density of residential development in their communities. Increases in the number of single-family residential units were reported by all who reported increases. In addition, about 40 per cent reported increases in town-houses and multiple family units. When asked about changes in commercial, industrial, and recreational land uses in the entire 10-mile radius, more than two-thirds reported increases. Further, more than half reported additions to land zoned for commercial, industrial and recreational use.

Public agencies and private interests were encouraging some type of growth more often than they were discouraging it. More than 60 per cent of the regional economic development agencies and local governments encouraged growth. Fifty to sixty per cent of the county governments, utilities, and state agencies encouraged growth. Less than 10 per cent of the respondents reported that these interests ever tried to constrain growth and there was no difference between the hosts and the non-hosts regarding the encouragement and discouragement of growth. Most of those not promoting growth assumed a neutral position.

In conclusion, the US Census of Population data and the responses to the survey suggest that substantial growth has occurred and that substantial policies of growth encouragement have nurtured and will continue to nurture population growth in areas around nuclear power stations.

THE QUESTIONS ON GROWTH FACTORS

A second set of survey questions was aimed at determining the major locational factors responsible for land use changes. The factors contributing to growth are summarised in Table 3.

The respondents perceived major highways, proximity to urban areas, sewer and water systems, recreational areas, low taxes, and industrial development to be the key growth ingredients. The nuclear station itself ranked only eighth in influence on population growth and ninth on industrial development. Less than 30 per cent of those responding felt that the nuclear plant contributed directly to population growth and less than 20 per cent felt that it contributed directly to industrial development.

A different impression is gained when the 191 responses are separated into

Table 3 *Relative importance of different factors contributing to population and industrial growth*

Contributing Factors*	Population Growth		Industrial Growth	
	Very high and High	Medium	Very high and High	Medium
Major highway	41%	19%	40%	12%
Proximity to urban area	39	21	27	18
Recreation areas	29	21	13	18
Low taxes	26	21	18	19
Sewer system	22	22	25	19
Industrial growth	20	21	—	—
Drinking water system	22	18	27	15
Nuclear station	10	19	6	12
Navigable river/port	14	11	19	7
Rail line	10	11	22	14

* Ranking is in order of percentage of times the factor is mentioned as very high, high, and medium in contributing to population growth.

Source: Questions 7 and 8.

Table 4 *Relative contribution of different growth factors to population growth, host communities only*

Contributing Factors*	Population Growth	
	Very high and High	Medium
Low taxes	61%	14%
Nuclear station itself	43	29
Proximity to urban area	55	10
Major highway	51	14
Recreation areas	37	27
Industrial growth	35	27
Sewer system	37	12
Drinking water system	33	14
Navigable river/port	31	16
Rail line	18	18

* Ranking is in order of percentage of times the factor is mentioned as very high, high, and medium.

Source: Question 7.

host and non-host community types. Local tax payments jump out as the most important factor in population growth in the host communities (46 of the 49 responded). This is shown in Table 4. The nuclear station's large real property tax payments to local governments, which result in small tax obligations for all other community property owners, are mentioned by 61 per cent of respondents from high growth host communities as being important stimulants to population growth (Table 4). Recreational facilities, pipelines, and roads associated with the nuclear station were reported as being important to growth, but only about half as often as local tax payments. Overall, these data clearly pinpoint property tax revenue as the most important factor in population growth in the host communities.

The significance of the local tax payments is even more striking when the responses are separated into three groups: non-hosts, low-growth hosts, and high-growth hosts. More than 75 per cent of the high-growth host communities

Table 5 Relative contribution of nuclear station's taxes and skilled work force to population and industrial growth by community type

Community type	Percentage of High and Medium Contribution					
	Local tax payments			Skilled work force		
	Number	%	p*	Number	%	p*
High-growth hosts	9	75.0	<.001	1	8.3	†
Slow-growth hosts	19	55.9	<.001	15	44.1	<.01
Non-hosts	18	12.5	—	25	17.2	—

* Difference of proportions test; one-tailed test that host communities are significantly higher than non-hosts.

† Not significantly different at $p < .10$.

Source: Question 9.

reported that local tax payments were a key factor in local population growth compared to 56 per cent in slow-growth hosts and only 12 per cent of the non-host communities (Table 5). Other growth factors were less important than tax payments, yet their effects also varied by community type. Host communities felt a stronger influence from the skilled work force associated with the plants than did non-host communities, but the skilled work force factor was not very strong in the 12 high-growth host communities (Table 5).

Corroborating evidence on the strength of the revenue payments as a growth factor was found in three other questions. A substantially greater proportion of the host than the non-host communities reported that plant tax payments were important to general revenue; 76 per cent host, 14 per cent non-host (one-tailed $p < .001$). The 76 per cent for the host communities is probably understated because 17 per cent of the host communities were 'not sure' of the importance of revenue to the budget. Only three of the 46 host communities felt that plant tax payments were not important.

These responses were not unexpected. The local fiscal impact of the privately-owned nuclear power station is considerable. Property taxes remain low while public services are upgraded. Burchell⁴ found that a municipal government's revenues are usually doubled when it receives private power plant revenues; a county's revenues increase by 60 to 120 per cent; and a school district's revenues increase by an average of 40 per cent.

Another question asked for an opinion as to the effect of the presence of the local nuclear station on property values. The intent of the question was to determine if any negative impacts occurred, possibly as a result of the widely-publicised accident at Three-Mile Island in Pennsylvania in 1979. Most communities reported experiencing no change. Host communities reported experiencing increased property value with a significantly greater frequency than non-host communities (22 per cent v. 8 per cent, see Table 6). Nine of the 10 host communities that reported an increase in property values also reported that taxes from the station had a significant impact on the community's general revenues. The tenth respondent was unsure. Two of the four host communities sustaining a decrease in property values were reported to be receiving no station revenues. The host communities were also found to have a lower percentage of property value decreases than the non-hosts, although the difference was not statistically significant (Table 6).

Table 6 *Change in property values within 5 miles of the station since January 1980*

Community type	Values Increased			Values Decreased		
	Number	%	p*	Number	%	p†
All hosts	10	21.7	.02	4	8.7	**
Non-Hosts	11	7.6	—	25	17.4	—

* Difference of proportions test; one-tailed test that host communities are significantly higher than non-hosts.

† Difference of proportions test; one-tailed test that host communities are significantly lower than non-hosts.

** Not significantly different at $p < .10$.

Source: Question 19.

Table 7 *Relative importance of factors limiting growth*

Factors*	definitely yes and yes
Remote rural area	44%
Adjacent areas more attractive	31
Industrial decline	22
No major highway linkage	21
Planning policies	19
Commercial decline	17
Inferior municipal services	17
Agricultural decline	10
High taxes	10
Nuclear plant	8

* Ranking is in order of percentage factor mentioned as definitely yes and yes.

Source: Question 10.

The respondents were also asked about the role of locational factors in constraining growth. The nuclear station itself was reported to be a very unimportant factor in limiting growth (see Table 7). Less than 10 per cent of the respondents felt that the presence of the nuclear facility served as a constraint.

Nevertheless, some respondents revealed that the local nuclear station was important to the limitation of growth in the 10 mile radius area as a whole. Of these sites, all have received wide publicity and nine of the 10 are in the Northeast. Three were the communities hosting the Connecticut Yankee, Indian Point, and Three-Mile Island facilities. Three others were non-host communities adjacent to the Three-Mile Island site. The remaining four were non-host communities within 10 miles of Maine Yankee, Nine Mile Point, Peach Bottom, and Zion. But with the exception of these few sites, nuclear plants were rarely perceived as responsible for constraining area growth.

THE QUESTIONS ON PLANNING

The results of the questions on planning show that the respondents overwhelmingly believe that the nuclear power stations are not a major concern in land use planning matters. This is true even in the high-growth host communities.

To get a sense of the extent of involvement of the responding planners in land use matters near nuclear power stations, questions were asked about the extent of their local government's participation in the several stages of the power station's life, ranging from conception and planning of the station to post-construction land use controls. Such questions may seem strange to anyone unfamiliar with

the United States' land use control and planning mechanisms. Unlike more centralised and nationally integrated planning systems, virtually all land use planning and control is initiated and administered at the local level of government. The result is a system of local autonomy in which county, state, and national agencies are relatively powerless on most land use issues. Furthermore, the two functions of plan making and the making and enforcing of land use regulations are quite separate and often uncoordinated with each other. Thus it becomes perfectly reasonable to ask if federal guidelines of nuclear safety, which often do prevail in the laboratory and the hospital, have any effect on the actions of city hall. There is nothing inherent in the governmental system to impose the national or regional concerns for the isolation of populations from nuclear power plants on the competitive wills of the development-oriented local authorities.

In response to these questions, less than 10 per cent stated an involvement 'to a great extent' or even 'somewhat' in the early conceptualisation, construction, and hearings of their respective stations. The record among those from the 12 high-growth communities was about the same as the full set. One explanation of the lack of early involvement may be the high rate of turnover in political and agency positions. But this is not the only explanation. The written comments clearly suggest that most land use planning efforts in the mid-1960s ignored the plants and did not expect nuclear power stations to induce important land use changes.

By the mid-1970s, planners had taken a much greater cognisance of nuclear stations and their effects. More than 75 per cent felt very knowledgeable or somewhat knowledgeable about the stations' effects. Fifty-four per cent reported that they had worked on land use issues since the facilities became operational. More than half of the respondents were substantially involved in evacuation planning and other forms of planning related to those facilities.

The participation record in the 12 high-growth host communities was better. All reported involvement. Ten (83 per cent) reported either a great deal or some participation in land use issues relating to the plants since they had become operational. Only two had participated during the earlier planning, hearing, and construction phases.

The usual array of planning and land use control devices are being used to guide area development. Over 70 per cent of all respondents reported that comprehensive master plans, zoning ordinances, building codes, and subdivision regulations had been officially adopted. More than 40 per cent reported the adoption of large-lot zoning, cluster or PUD (Planned Unit Development) zoning, performance standards in zoning, and disaster plans or controls. Less than 25 per cent of the respondents reported the adoption of newer types of land use control initiatives: coastal zone management, farmland preservation, controlled growth, conservation restrictions, easements, transfer of development rights, and preferential tax treatment. The 12 high-growth host communities were found to have had a greater degree of legal control. Almost every one of them had a master plan, a zoning ordinance, subdivision regulations, and flood plain protection ordinances, but few mentioned having the newer types of growth control devices.⁵

The vast majority of land use changes made in the communities were the result

of development unrelated to the nuclear power stations. Less than 10 per cent of the adoptions and revisions of land use control mechanisms were made in direct response to the nuclear power stations. Indeed, among the changes that involved land use, only disaster plans were consistently mentioned as being done in direct response to the existence of the nuclear stations. Their production was, of course, directly caused by the presence of the nuclear stations.

The mix of planning and code enforcement in these communities is typical of small American municipalities. Over 60 per cent of the respondents reported the existence of a local zoning board of commission; planning board or commission; code administrator; subdivision and site plan review board; and a regional planning staff. Forty-two per cent reported having a professional planning staff and 43 per cent reported contracting with consultants for local planning services.

The 12 high-growth host communities had a similar profile of responses with one exception. The exception was that all 12 reported the existence of regional planning staffs, compared to 73 per cent of the total of respondents. A review of these 12 showed that many of these regional planning staffs had been directly involved in station siting activities. However, they were far more involved with non-nuclear power plant related issues, so one cannot conclude that the creation of the regional planning agencies was in response to the nuclear power stations.

The conclusion that nuclear power stations did not have much effect on the creation and activity of planning organisations and the development of land use controls was confirmed by the responses to another question. Only 18 per cent of the respondents felt that the presence of a nuclear station actually stimulated changes in their area's land use control efforts. Moreover, nearly all of those who did note any effect said that the station was only 'slightly' responsible.

Apparently, the nuclear power stations did foster more regulation in the 12 high-growth host cases. Five of the 12 directly attributed some of the need for additional land use controls to the presence of the nuclear station. Nearly all, however, attributed an equal amount or more of the need to other growth factors.

The low levels of concern about the impact of nuclear stations on land use and population change was further confirmed by responses to other questions. Seventy-seven per cent of the respondents felt that residential densities and land use changes were consistent with their land use goals and that planning and land use management tools were adequate to handle anticipated future changes. Less than 40 per cent of the respondents anticipated the need for new growth management techniques. Furthermore, although we had expected greater concern, the responses of the 12 high-growth communities were about the same as the larger set.

Lastly, when asked directly about the impact of the Three-Mile Island accident on land use and development controls, only about 20 per cent mentioned any impact. The vast majority stated that there were no negative effects.

Implications for planning

The strong links found here between attitudes, taxes, and growth have policy implications for nuclear regulation as well as possibly for the siting of a broader

group of potentially hazardous facilities, dubbed LULUs by Popper.⁶ LULUs (Locally Unwanted Land Uses) are a class of projects that are regionally or nationally needed (or wanted) but objectionable to those who might live near them; e.g., airports, waste disposal sites, oil refineries, hazardous chemical management facilities. The implication for nuclear regulation is that if the distribution of tax benefits were changed, it might change attitudes and greatly reduce the population at risk. This has already been done in Pennsylvania, Iowa and Wisconsin where the state assesses and taxes the nuclear power plant, collects the property tax revenues, and distributes it among local governments on a shared basis.⁷ The logic of such intervention is that by discouraging growth, not encouraging it, not only will the number of residents and workers potentially exposed to accidents be limited, but evacuation and other emergency planning will be greatly simplified.

Two arguments can be made against these changes in growth policies. One is that people living near a nuclear facility, chemical plant, or hazardous waste management facility deserve to be specially compensated for their risk.⁸ Revenues might be considered their compensation if they did not also prove to be an attractive force for growth. In essence this is an argument that residents have a right to gamble with their own personal safety and a right to the winnings (tax benefits) of such a gamble. The argument appeals to the tradition of American individualism and enterprise; but it fails. When the gamblers lose in this situation they do not, and indeed cannot, bear the full costs of the loss. Their gambling entails a much larger set of social risks and long-term costs to the society at large if they should lose. An accident at a nuclear or chemical plant that emitted hazardous substances into the atmosphere would be serious. One which emitted substances which killed or injured people and damaged property, when such injury and damage could have been prevented by land use controls, should generate, one would think, support for the already widely held belief that governments and industries are trading lives and the future for relatively few dollars in rateables. One need only review the news coverage of the Bhopal incident to recognise the mistake that was made there of allowing people to establish homes adjacent to what had been an 'remote' location.

A second argument against more direct control is that the vast majority of those questioned in this survey believe that existing land use management tools are adequate to handle anticipated population growth and other land use changes. Thus it is unnecessary to intervene further. There are several plausible defenses of this view. The stations have generally not had a major impact on population and land use. The immediate sites surrounding most nuclear power stations are, in fact, naturally controlled because they are in remote locations, have environmentally resistive buffer areas (lakes and rivers), and are on privately owned lands. Even when revenues from the nuclear plants do induce people to move into a host community, the new development, it can be argued, can be channelled and directed by public decisions on the location of highways, sewer and water lines, and zoning to parts of the communities that are away from the nuclear facility.

This argument also fails. It is equivalent to saying that if the theatre catches fire, be sure that you are seated near the exit. The difficulties with this advice are,

firstly, that everyone cannot be seated by the door. If the theatre is full, some will have to sit elsewhere. Secondly, and more importantly, there is, in fact, no well-defined exit. That is to say, the strategy fails because of the uncertainties associated with potential nuclear facility accidents. How serious will the accident be? Which back-up systems will fail? What will the local meteorological conditions be? If evacuation of population is required, how smoothly and quickly can it be achieved? We do not know the answers to these questions. In the light of these and other associated uncertainties, the Nuclear Regulatory Commission adopted the only reasonable policy available: to locate plants on sites remote from urban centres and in areas of low population growth. All things considered, it was and still is a good policy. But as the results of this research show, it is not working to control growth after the plants have been sited and have become operational. It seems in this case that we have left the barn-door open and, contrary to the metaphor, the barn is filling up.

NOTES AND REFERENCES

1 US Nuclear Regulatory Commission, *Report of the Siting Policy Task Force*, NUREG-0625, 1979; and US Nuclear Regulatory Commission, *General Site Suitability Criteria for Nuclear Power Stations*, Regulatory Guide 4.7., USNRC, 1975.

2 Greenberg, M., Krueckeberg, D. and Kaltman, M., 'Population trends around nuclear power plants' in Pasqualetti, M. and Pijawka, K. (eds.), *Nuclear Power: Assessing and Managing Hazardous Technology*, Boulder, Westview Press, 1984, pp. 189-211.

3 A copy of the questionnaire may be obtained from Dr Greenberg or Dr Krueckeberg.

4 Burchell, R., *Fiscal Conditions of Nuclear Plant Sites: A Survey of Fiscal Conditions and Case Studies of Revenue and Expenditure Disposition*, a Report submitted to Brookhaven National Laboratory, 1982.

5 Pearlman, Kenneth and Waite, Nancy, *Land Use Controls in Communities Near Nuclear Power Plants: A Policy Analysis*, a Report submitted to Brookhaven National Laboratory, 1983.

6 Popper, F., 'LULUs: locally unwanted land uses', *Resources*, 73, 1983, pp. 2-4.

7 McMahon, R., Ernst, C., Miyares, R. and Haymore, C., *Using Compensation and Incentives When Siting Hazardous Waste Management Facilities—A Handbook*, Washington DC, USEPA, 1982.

8 O'Hare, M., Bacow, L. and Sanderson, D., *Facility Siting and Public Opposition*, New York, Van Nostrand Reinhold, 1983; Morell, D. and Magonian, C., *Siting Hazardous Waste Facilities*, Cambridge, Mass., Ballinger, 1982.